

Elastic Films for Cryogenic Skin Friction Measurements, Phase I

Completed Technology Project (2009 - 2009)



Project Introduction

Here we introduce a new sensor for measurement of skin friction and pressure, Surface Stress Sensitive Film (S3F). This technique can operate over a range of temperatures from cryogenic (160 K, -113aC) to well above ambient (470 K, 197aC). The operation of the sensor is based on the deformations of an elastic film that distorts under the action of the applied normal and tangential loads. Skin friction and pressure gradients are determined by monitoring these distortions and applying a finite element model to the film. Quantitative measurements of skin friction and pressure have been demonstrated on aerodynamic models from 10-m/s to Mach 5. Among these tests was an experiment that included S3F on one side of the model and PSP on the other side. Data from each sensor was acquired simultaneously, thus demonstrating the compatibility of the S3F with existing PSP hardware. Tunnels with existing PSP systems could be upgraded to include skin friction capability. The opportunity to develop this sensor system for measurements of skin friction in production facilities, including cryogenic tunnels as well as tunnels with operating temperatures up to 200C, is recognized and this is the focus of this proposal.

Anticipated Benefits

Potential NASA Commercial Applications: Non NASA commercial applications of this technology are mostly in the bio-medical field where measurements of skin friction are essential to the design of artificial implants to minimize the occurrence of clotting. Also with respect to contact force measurements, ISSI has developed a sensor based on the S3F technology which is being used to study the effect of shear and on diabetic ulceration in feet. In conjunction with these proof of concept tests, ISSI has recently developed a commercial Pressure Sensitive Paint system. The components of the skin friction technology have been developed to be compatible with this commercially deployed system and therefore, extension of these systems to include skin friction measurements is offered as a system upgrade. Over the past 12 months, eight complete systems and several components have been sold with total revenue of over \$500,000.



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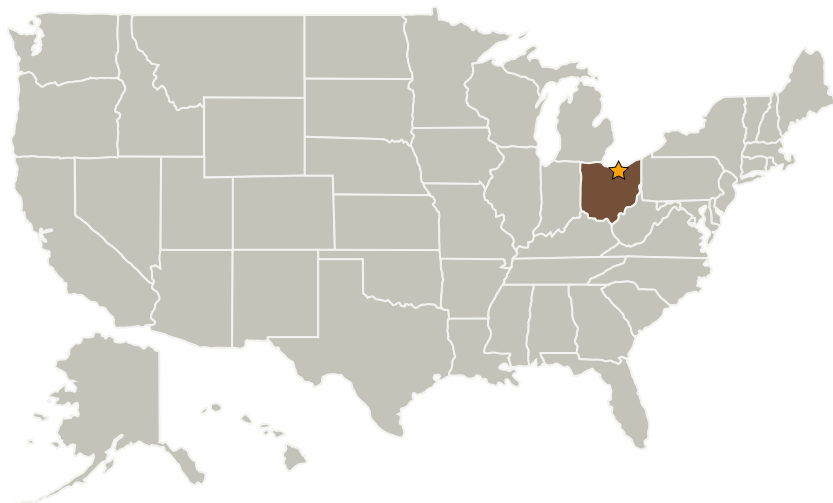
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Glenn Research Center (GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Innovative Scientific Solutions, Inc.	Supporting Organization	Industry	Dayton, Ohio

Primary U.S. Work Locations

Ohio

Project Transitions

**January 2009:** Project Start**July 2009:** Closed out

Closeout Summary: Elastic Films for Cryogenic Skin Friction Measurements, Phase I Project Image

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

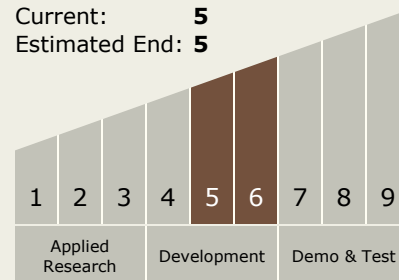
Carlos Torrez

Principal Investigator:

Jim Crafton

Technology Maturity (TRL)

Start: 6
Current: 5
Estimated End: 5



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Technology Areas

Primary:

- TX15 Flight Vehicle Systems
 - └ TX15.1 Aerosciences
 - └ TX15.1.1 Aerodynamics